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## Coenzyme-A "The Master Coenzyme"

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### Introduction

The nutritional requirements of the human body can rarely be met through a well balanced diet; dietary supplements, including vitamins are often required to sustain good health. Coenzyme-A Technologies Inc. has applied new technology to the formulation and manufacture of a series of proprietary products, which address nutritional deficiencies that result from the stress of modern day living, chemical imbalances within the body, and the effects of aging. These nutraceutical products are the first to provide people with a balanced combination of highly active nutritional components that can be used by the body to support its manufacture and utilization of Coenzyme-A. In addition, certain products also contain their own set of specific substances that support Coenzyme-A's correction or alleviation of particular problems associated with certain nutritional deficiencies. It's important to know why Coenzyme-A Technologies Inc. refers to Coenzyme-A as "The Master Coenzyme"; the reason is set forth below.

The human body is composed of trillions of cells. Each of these cells is made of various chemical molecules that perform certain vital biochemical functions as programmed by the cell's deoxyribonucleic acid molecule (DNA). Certain genetic instructions are transferred from DNA to the ribonucleic acid molecule (RNA) to facilitate the manufacture of amino acids into proteins (enzymes, structural molecules and polypeptide hormones). Millions of continuously occurring biochemical functions that are necessary to sustain life require the presence of enzymes. It is important to recognize that, as is the case with all chemicals, each enzyme's chemical structure, not its natural or synthetic source, determines its function.

### What is an enzyme?

An enzyme is a protein substance which acts as a catalyst to initiate or accelerate a chemical reaction that supports digestion or metabolism by specifically acting upon a particular substance or class of substances. Although enzymes are not always destroyed during such chemical reactions they pass out of the body and should be replenished on a daily basis.

### What is Coenzyme-A?

Coenzyme-A is the most active metabolic enzyme in the human body. Coenzyme-A operates in the body's cells and blood where it is required by metabolic processes that facilitate more than one hundred chemical reactions. Every organ of the body has Coenzyme-A in its tissues because every part of the body has a use for it. Coenzyme-A is constantly expended by the metabolic processes of the body and constantly needs replenishing.

### How do enzymes work?

**Digestive enzymes operate in the body's digestive tract.** These enzymes initiate the chemical reactions that break down and digest the proteins (amino acids), carbohydrates (sugars and starches), and lipids (fats and oils) that are contained in foods. These reactions begin when any food enters the mouth and continue as the food is chewed, swallowed, passed through the stomach into the intestines and absorbed through the walls of the small intestine for transmission by the bloodstream to other parts of the body.

**Metabolic enzymes operate in the body's cells and blood.** Metabolism is a general term for the biochemical processes through which the body changes air, food and other materials into the substances it needs to function properly. Metabolic enzymes facilitate the chemical reactions that carry out the processes of metabolism. Typically, metabolic enzymes are composed of two components: (1) an "apoenzyme" that identifies which molecule within a cell requires a specific chemical reaction and (2) a "coenzyme" that initiates the specific chemical reaction.

The body's primary sources of energy are produced at the cellular level by metabolic processes. Coenzyme-A (CoA), Acetyl Coenzyme-A (acetyl CoA), Coenzyme Q10 (CoQ10) and

Coenzyme 1 (NADH), together with certain B-vitamins and their coenzyme forms are necessary for such energy production during: (1) the tricarboxylic acid cycle (the TCA cycle, Krebs cycle, or citric acid cycle) and (2) the glycolytic cycle.

The TCA cycle and glycolytic cycle are responsible for the production of about 95% of the energy the body requires to sustain life. The TCA cycle requires oxygen; it provides the most efficient chemical pathway for the body's production of aerobic energy. The glycolytic cycle does not require oxygen; it provides an inefficient chemical pathway for the body's production of short interval high outputs of anaerobic energy.

#### **What are coenzymes made of?**

Coenzymes are generally made from the B vitamins such as B-1 thiamin, B-2 riboflavin, B-3 niacin, B-5 pantothenic acid, B-6 pyridoxine, or B-12 cobalamin. Coenzymes may be a vitamin, contain one, or be manufactured in the body by combining a vitamin with one or more other substances (as in the case of Coenzyme-A). **Coenzyme-A is a very important coenzyme that deserves special recognition.** While it is not uncommon for a coenzyme to be a requirement of several metabolic processes that may facilitate a number of chemical reactions, Coenzyme-A is required by metabolic processes that facilitate more than one hundred chemical reactions. Coenzyme-A is manufactured in the cells of the liver and other body organs from components transported by the blood. The highest concentrations of Coenzyme-A are found in the liver, heart, kidneys, brain, adrenal glands, and skeletal muscles. However, literally every organ of the body has Coenzyme-A in its tissues because every part of the body has a use for it.

#### **What does Coenzyme-A do?**

Since its discovery in 1947, Coenzyme-A's crucial importance to a host of metabolic processes has been recognized and intensively studied. **First and foremost**, Coenzyme-A initiates the above mentioned TCA cycle. As the TCA cycle's initiator, Coenzyme-A is indispensable to the body's primary method of producing more than 90% of the energy that powers the body's life processes.

**Second, but hardly less important**, Coenzyme-A initiates the manufacture of a wide variety of specific substances that the body requires. These substances include the neuromuscular messenger and neurotransmitter acetylcholine produced in the brain, the steroid hormones produced in the adrenal glands: aldosterone, hydrocortisone, and the sex hormones (the male androgens, and the female estrogen and progesterone). These sex hormones are also produced in the male testes and female ovaries. Acetylcholine is important to certain operations of the brain: as a neuromuscular messenger it enables nerves to communicate with muscle cells; as a neurotransmitter it carries messages between nerves to parts of the brain affecting primitive emotions, responsiveness to outside stimuli, memory, learning and long-term planning. Aldosterone regulates sodium, potassium and water balance in the body. Hydrocortisone (cortisol) primarily helps control the sugar levels in the blood and liver; however, it also interacts with other organs, glands, the central nervous system, and plays an important role in the body's reaction to stress. The androgens (such as testosterone or androsterone), estrogen and progesterone support the development and operation of the sex organs essential to human existence.

**Another crucial function** of Coenzyme-A is its performance as the "universal acetate carrier"; it is the primary biological substance (cofactor) used in acyl transfers. Coenzyme-A initiates the fatty acid metabolism that breaks down and degrades the long molecular chains of fatty acids by adding or removing acyl groups. It also supports pyruvate oxidation and other acetylation reactions. Effective fatty acid metabolism is essential to the avoidance of the high levels of cholesterol and triglycerides, and the high lipid levels that are characteristic of patients with cardiovascular or diabetic disorders. Also, Coenzyme-A supports the immune system's detoxification of many dangerous substances, activation of the white blood cells (that kill and remove invaders), and the formation of the hemoglobin required to produce red blood cells. Additionally, it supports the immune system's repair of RNA and DNA, and ability to heal physical injury. Further, Coenzyme-A facilitates the manufacture of some very important components of connective tissue. Two of these components, chondroitin sulfate and hyaluronic acid (which is made in part from glucosamine), are necessary to the formation and repair of cartilage.

**What is Coenzyme-A made of?**

Coenzyme-A is manufactured in the cells of the body from three components: adenosine triphosphate (ATP), cysteine, and pantothenic acid (vitamin B-5). The body can manufacture both ATP and cysteine by synthesis; however, pantothenic acid is an essential vitamin that the body does not produce.

**What is the source of Coenzyme-A?**

There are no food sources for Coenzyme-A as a chemical compound. The cells of the body manufacture Coenzyme-A from the three above mentioned components: ATP, cysteine, and pantothenic acid. All three of these Coenzyme-A components must be provided by way of the foods or synthetic dietary supplements digested by the body. At this time, Coenzyme-A is not commercially available in the form of a one compound synthetic dietary supplement. Further, it is doubtful that a compound of Coenzyme-A would be an effective dietary supplement because the digestive process would break such a compound back down into its components before it entered the bloodstream. Coenzyme-A is not manufactured during the digestive process, it is manufactured in the cells of the body! This is why each of the nutraceutical products offered by Coenzyme-A Technologies Inc.™ contains a balanced combination of components that are used by the cells of the body to manufacture and utilize Coenzyme-A.

**How important is Coenzyme-A: "The Master Coenzyme"?**

Everyone knows that human life depends upon the availability of oxygen; few people know that Coenzyme-A is just as important!

**Coenzyme-A:**

- Initiates hundreds of important processes in the body.
- Reduces the damaging effects of stress and slows the deadly processes of aging.
- Initiates the TCA cycle that produces more than 90% of the energy the body requires to sustain life.
- Initiates the chemical reactions required by the human body to utilize Coenzyme Q10, Coenzyme 1 (NADH/Enada) and many of the other nutrients the body needs to stay healthy.
- Initiates the manufacture of the specific substances that facilitate critical functions of the brain and adrenal glands.
- Supports the development and functions of the male and female sex organs that are essential to human existence.
- Acts as the "universal acetate carrier"; it is the primary biological cofactor used in acyl group transfers. It initiates the metabolism of fatty acids, and supports pyruvate oxidation and other acetylation reactions.
- Supports critical functions of the immune system and facilitates the repair of RNA, DNA and physical injury.
- Facilitates the manufacture of connective tissue and the formation and repair of cartilage.
- Enhances physical performance and reduces the build up of lactate.

**What are the symptoms of a deficiency of Coenzyme-A?**

Signs and symptoms of a Coenzyme-A deficiency included: depression, anxiety, loss of appetite,

impaired sense of balance, easy irritability, fatigue, frequent respiratory infection, cardiac instability, and abnormal need for sleep. Neurological disorders included: numbness, muscle weakness, cramps, abdominal pain and paresthesia (abnormal sensations such as itching and prickling, tingling extremities, and "burning feet" syndrome). Biochemical changes included: increased insulin sensitivity, lowered blood cholesterol, decreased serum potassium, and failure of adrenocorticotropin (ACTH) to induce eosinopenia.

Based upon the genetically determined life span of humans, a normal person has the potential for living a healthy life for over 100 years. As life proceeds, the actual rate at which aging progresses depends upon: (1) the ratio of damage to repair of the body's tissues, cells and molecules, and (2) the progressive loss of body functions. Aging accelerates as time passes. There is evidence that sensory mechanisms (time clocks) in the testes, ovaries, pituitary, and hypothalamus measure accumulated damage and begin to decrease their effective function when such damage reaches a critical level.

Damage to DNA and deterioration of the immune system are both recognized as major causes of aging or premature death. The diseases of age that usually cause disability or death such as arthritis, multiple sclerosis, parkinson's, alzheimer's, adult on-set diabetes, cancer, arteriosclerosis, etc. are usually prevented or alleviated by a well-functioning immune system and healthy DNA. As noted above, Coenzyme-A supports critical functions of the immune system and facilitates the repair of RNA and DNA.

The body has the capacity to manufacture certain nutrients, but not essential vitamins such as pantothenic acid (B-5). However, in addition to taking essential vitamins as a supplement, it is also advantageous to take certain nutrients as dietary supplements. Otherwise, the body must expend raw materials and scarce resources such as enzymes and coenzymes to manufacture the necessary nutrients. Further, as the body ages, its ability to efficiently manufacture and utilize the quantity of nutrients required to maintain good health progressively decreases.

Aside from defective genes, or bacterial and viral diseases, the inability of the body to slow or partially reverse the deadly processes of aging can stem from nutritional deficiencies. Unfortunately, it is sometimes difficult to detect a dietary deficiency; however, the effect of most dietary deficiencies is cumulative and the effect of some may be irreversible (and perhaps fatal). Consider the importance of Coenzyme-A, "The Master Coenzyme"! Why risk a dietary deficiency of Coenzyme-A that could affect the quality or duration of life?

#### **How does the body obtain sufficient Coenzyme-A?**

The U.S. Food and Drug Administration (FDA) has established Recommended Daily Dietary Allowances (RDAs), currently referred to as Reference Daily Intakes (RDI's). These FDA recommendations were not determined by scientific studies. They represent the amounts of proteins, vitamins and minerals the FDA believes a healthy person needs to ingest each day to obtain essential nutrients.

The FDA has not established the amounts of vitamins, minerals, trace elements, and other nutrients a person needs to attain and sustain the optimal level of health required to enhance both the quality and duration of life. When it comes to a person's health and longevity, there is a big difference between "adequate" and "optimal".

In the FDA's 1980 tables, an adult person's RDA for pantothenic acid (vitamin B-5) was 4 to 7 milligrams (mg). The FDA's current RDI is 10 mg. for an adult person. That's progress? Even the basic dietary food supplements of multiple vitamins provide a much larger daily dosage.

Only a limited amount of research is currently available regarding the amount of pantothenic acid a person needs to satisfy optimal daily requirements. According to the clinical research done in Hong Kong, China by Lit-Hung Leung, M.D., daily dosages of up to 10 grams of pantothenic acid were applied to obtain long term optimum nutrition and health benefits. Up to 10 grams more were applied to obtain optimum therapeutic results for specific ailments. Throughout the one year duration of this clinical research program, no toxicity (from the daily dosages of up to 20 grams of pantothenic acid) was observed in the participants. This major study was published in the scientifically prestigious Journal of Orthomolecular Medicine, Volume 12, Number 2, 1997. Many other major studies, reporting on the use of mega doses of pantothenic acid under

clinical conditions have been published in this same Journal.

It is important to know that pantothenic acid (vitamin B-5) is an essential vitamin that the body does not produce. The food sources richest in pantothenic acid are animal protein (organ meats such as liver) and natural vegetable sources such as raw fresh mushrooms and broccoli. Most fresh fruits and their juices contain only small amounts. Aside from the quantity and varieties of foods that must be consumed daily to obtain optimum nutrition (including vitamin B-5), the preparation of such food presents another problem; heat, food processing and preservation techniques, and canning destroy some or all of the pantothenic acid such foods contain. Another problem encountered when trying to establish optimum daily dietary recommendations is the human digestive system's variation in efficiency between individuals.

It is essential to understand that while pantothenic acid circulates in the blood in its pure vitamin form, it is stored in the cells of the body only as a component of Coenzyme-A. **It is Coenzyme-A that initiates the chemical reactions within the cells of the body that involve pantothenic acid.** Pantothenic acid is the primary cofactor of Coenzyme-A; however, it will pass out of the body without manufacturing Coenzyme-A unless sufficient adenosine triphosphate (ATP) and cysteine are both available. Both adenosine triphosphate (ATP) and cysteine can be manufactured within the body by synthesis. However, this requires the expenditure of raw materials and scarce resources such as enzymes and coenzymes. Further, the body's ability to efficiently produce such substances declines with age.

The most reliable and cost effective method of providing the body with the resources necessary to obtain an optimum daily supply of Coenzyme-A is to use Coenzyme-A Technologies' proprietary nutraceutical product **Coenzyme A™**. Coenzyme-A Technologies Inc. is the world's first developer of effective Coenzyme-A and Acetyl Coenzyme-A products. In the manufacture of its products Coenzyme-A Technologies combines the latest technology with the highest quality ingredients. These nutraceutical products are the first to provide people with a balanced combination of highly active nutritional components that are used by the cells of the body to support its manufacture and utilization of Coenzyme-A. In addition, certain products also contain their own set of specific substances that support Coenzyme-A's correction or alleviation of particular problems associated with certain nutritional deficiencies. One of the reasons why Coenzyme-A Technologies' products are so effective is because we use a scientifically formulated balanced combination of top quality, highly active natural components in the manufacture of our products.

The nutrients supplied by Coenzyme A™ also help the cells efficiently deliver fuel from aerobic and anaerobic metabolism to the TCA cycle for energy release. Because the human body can rapidly absorb these nutrients, Coenzyme A™ can be taken by an athlete shortly before a workout or sport performance to provide extra metabolic power when they need it the most.

Even if a person goes to the expense and difficulty of taking 10 or more grams of pantothenic acid a day, they will not know if their body is obtaining an appropriately balanced combination of the other components required by the cells of their body to manufacture Coenzyme-A. Coenzyme-A Technologies' **Coenzyme A™** offers a reliable daily dose of Coenzyme-A at a much lower cost. It's obvious that Coenzyme-A Technologies' products are the best choice!

Coenzyme-A Technologies' **Coenzyme A™** and the complete **Image™** line of nutraceutical products can be found at your better health food stores or visit Coenzyme-A Technologies' web site at [www.coenzyme-a.com](http://www.coenzyme-a.com) for more information about its products.

### **Coenzyme-A "The Master Coenzyme" - Your Body Can't Live Without It!**

The statements contained in this article have not been evaluated by the U.S. Food & Drug Administration (FDA). The products discussed are not intended to diagnose, treat, cure, or prevent any disease.

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